



Safe Navigation with GPS

Navigating with GPS while Hiking and Boating

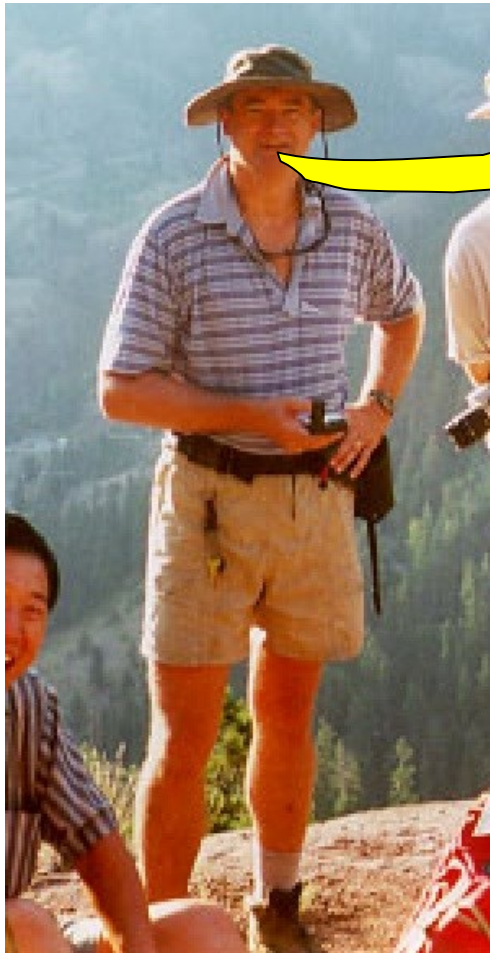


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Navigation questions

I ask when I'm
outdoors



Or maybe I really want to ask that dreaded question ...

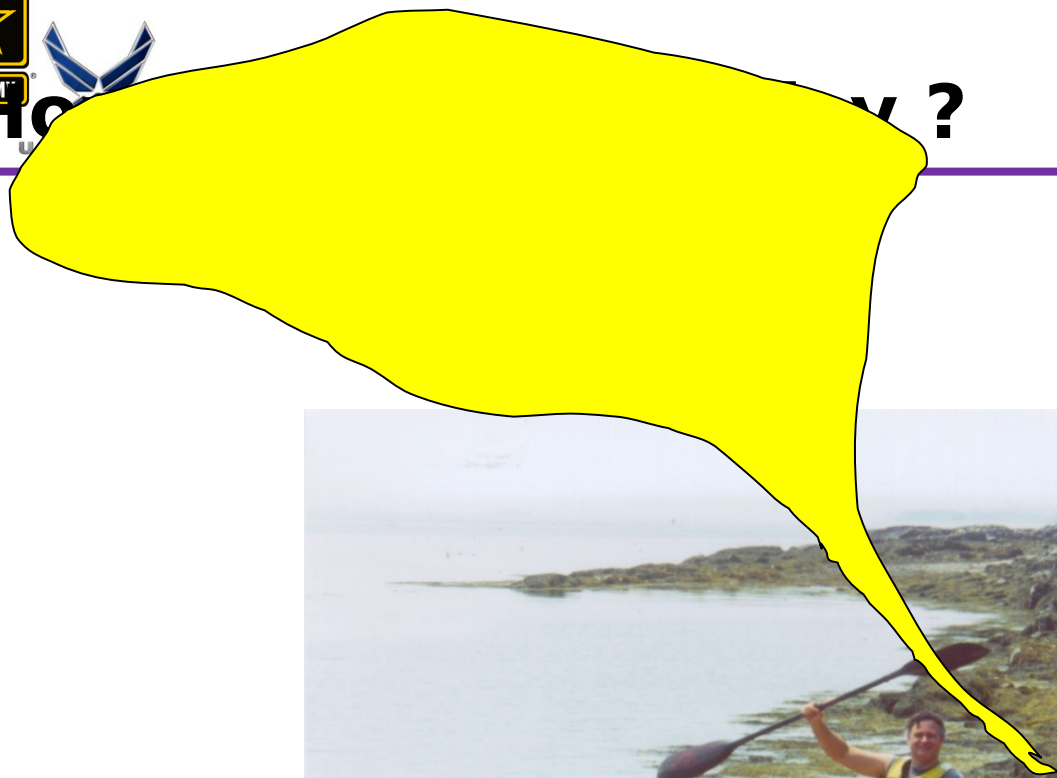


or more optimistically ...



HO

Y ?



or alternatively

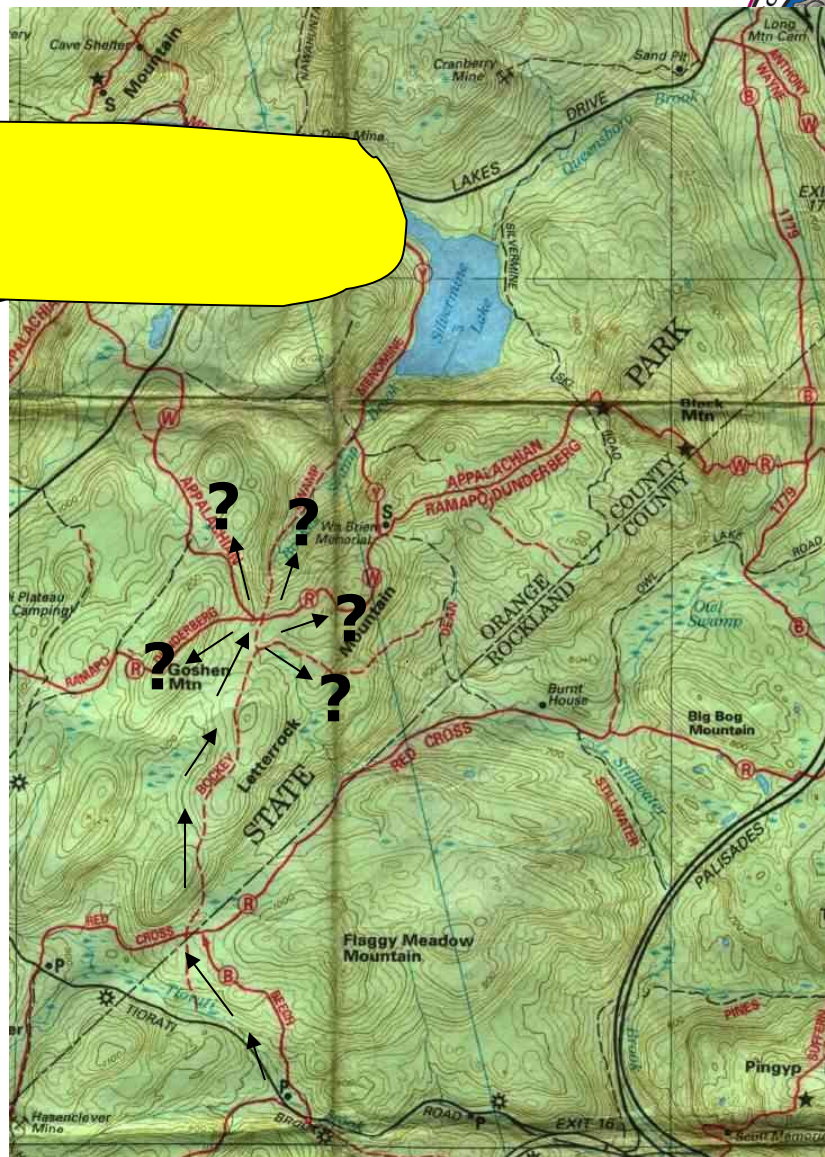
...

do I have to
go ?



Or even better ...

Am I really

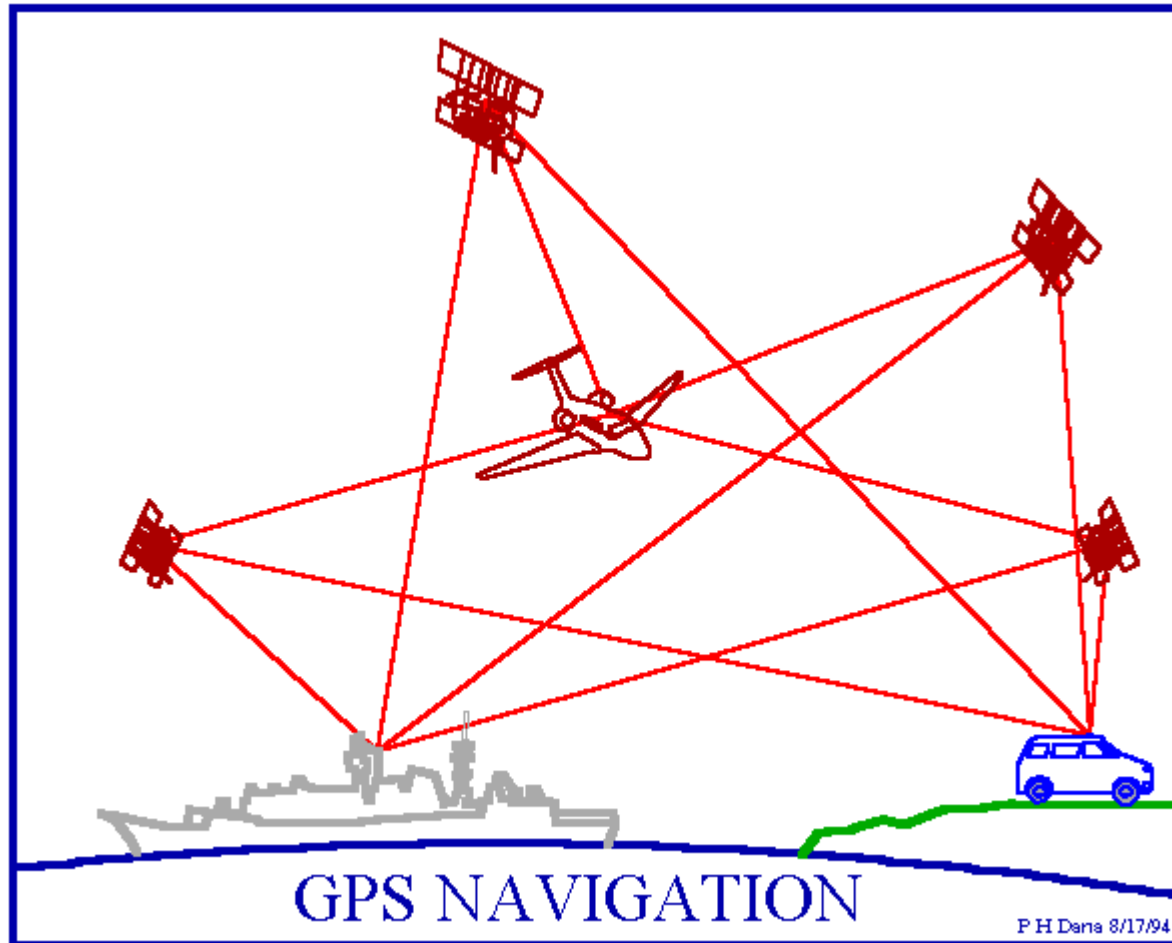


or finally ...

How fast am I going ?



Global Position System





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What GPS Gets You



Your precise location ...
... but only if you can see the sky

Your elevation ...
... but not especially accurately

Your direction and speed of motion
... but only if your moving!



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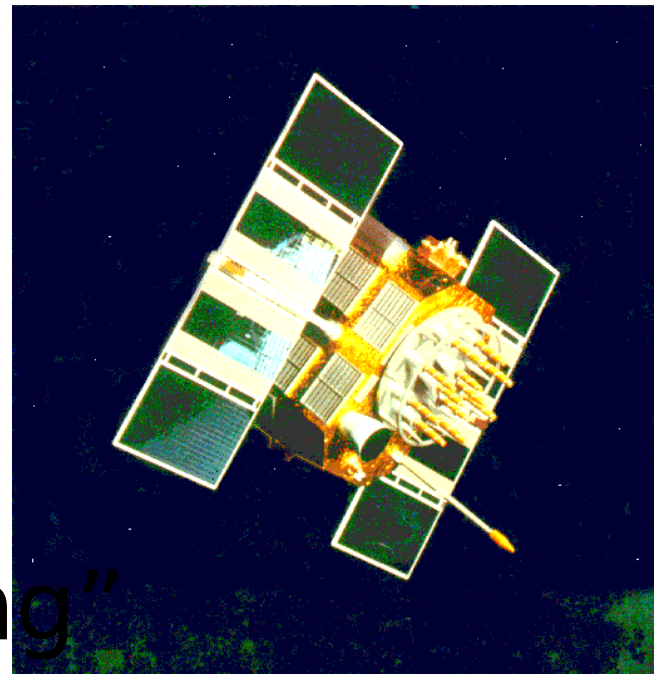
How GPS Works



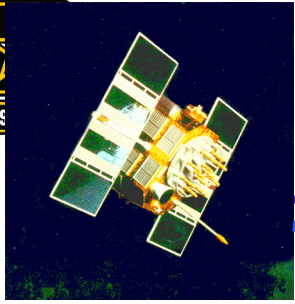
satellites (about 24)
in orbit around the
earth broadcast
(at 1575 MHz):

a precisely-timed “ping”

their own precise positions



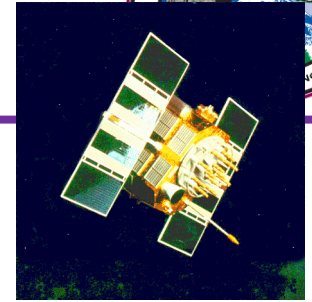
GPS Receivers



**Receive the satellite broadcasts,
and**

**determine the distance to each
satellite
by the time it takes the ping to
travel from
the satellite to the receiver**

**determine the position of the
receiver by
triangulating the known position of
at least **four** (but better 6 to 12)
satellites**





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Many Models of Receivers



Price anywhere from \$100 to \$1000+



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Receivers all equally good



at determining your
position

but differ in added features:

Water resistance

Power consumption

Built in map database

Ability to communicate with PC

Amount of Memory

Display size

Built in barometer

Built in magnetic compass

WAAS capability

HIGH

Importance
(in my opinion)

LOW



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Water Resistance



In my opinion ... a GPS receiver that is not 100% waterproof is 100% worthless



I never have a problem keeping my GPS receiver dry !





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Power Consumption



What kind of batteries does it take ?

I prefer units that use AA's, since AA's are cheap and readily available

How long does it last ?

I prefer units that last at least 12 hours on 2 AA's (I leave them on all day and change the batteries every morning).

Beware: Some GPS watches often use expensive batteries that last just a few hours !



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Map Database

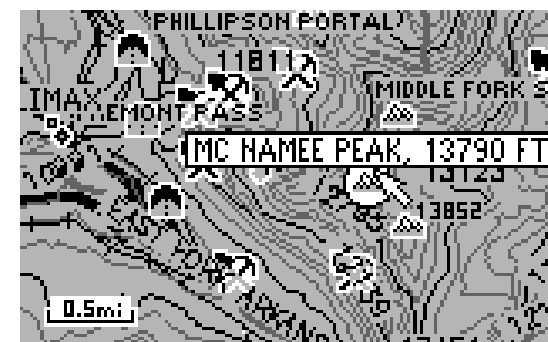
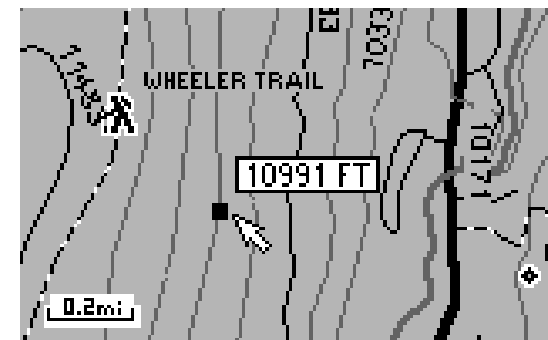
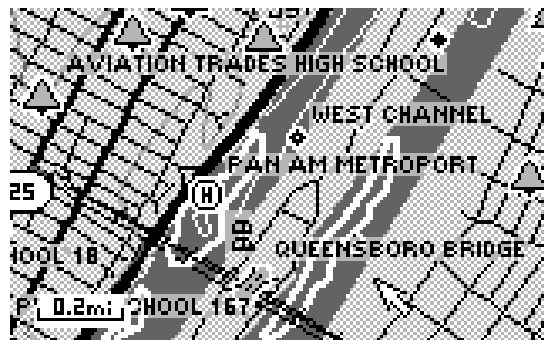


**Digital map quality is getting better every year,
but in my opinion is not yet as good as
the quality of printed maps.**

**On the other hand, the ability to automatically
overlay your desired and actual route on a
map is very neat and useful.**

**in some applications (e.g. hazard avoidance) continu
plotting of position is vital**

Typical Digital Maps



Source: Garmin Mapsource



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Communicate with PC



In order to

save waypoints that you've collected

... I do this professionally, when I make geophysical measurements. But I've never seen the need to do it hiking.

download new maps

**... keep in mind that the maps are not free.
Figure on at least \$100.**

**download waypoints and routes
that
you've designed on your PC**



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Amount of Memory



Maps are memory hogs!

**The bigger the display
The easier it is to see a map**

but

**receivers with the largest displays
are bigger and heavier than receivers
with small displays**



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Built in barometer



**GPS ability to determine elevation
is poor**

**150 feet vertical
compared to
30 feet horizontal**

**measurements of air pressure can
improve elevation accuracy**

***On the other hand, how vital are precise
elevation measurements ?***



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Built In Magnetic Compass



GPS can only determine your direction of motion.

It give directions like a compass, but only when You're moving.

So if you're stopped (e.g. to compare the map to the terrain), you get no direction.

A built in magnetic compass solves this problem.

... but, at least with the receiver I use, you have to hold the receiver horizontally in order for the compass to work. You can't dangle it from the combing of your



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WAAS capability



The 30 foot error in GPS locations is mainly due to fluctuations high in the earth's atmosphere.

But these fluctuations are the same everywhere over a wide area.

A WAAS base-station measures the fluctuations and transmits correction factors to receivers by normal radio.

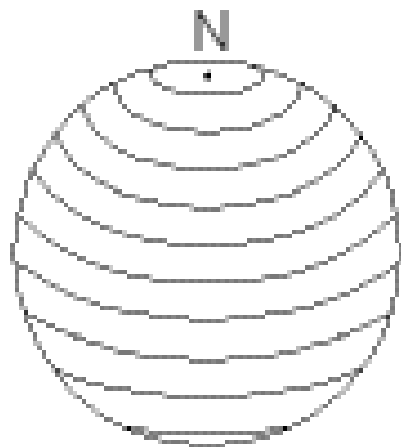
Thus reducing the error to about 5 feet.

In my opinion, WAAS is great for landing a plane on a narrow runway in fog, but it not relevant to hiking or recreational hiking or boating.



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GPS Coordinates

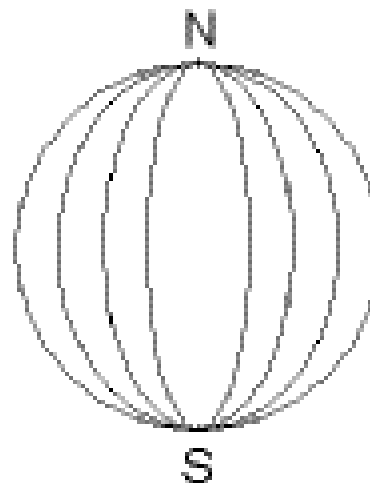


Latitude

North pole: 90°N

Equator: 0°

South pole: 90°S



Longitude

Furthest west: 180°W

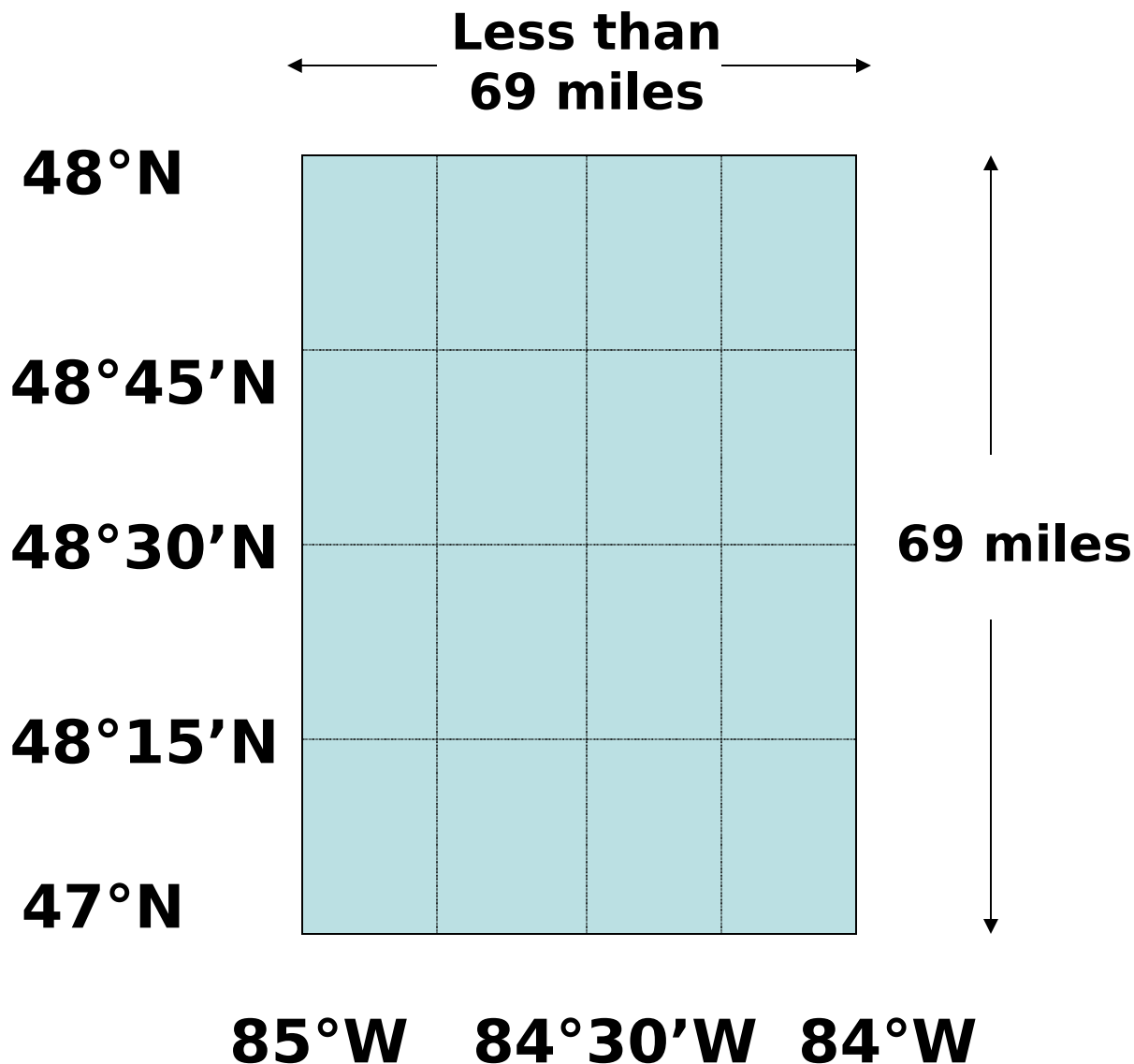
Greenwich, UK: 0°

Furthest East: 180°E



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1 Degrees = 60 minutes





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1 Minute = 1 Nautical Mile



**A minute of latitude, or “nautical mile” is
1.15 miles or 1.85 kilometers**

So

**If my map marked off in minutes
Its easy to gauge (rough) distances**

Navigation with GPS

In my opinion, GPS does not replace a printed map and compass.

I always carry map and compass, too.

**Safety is one reason.
I allow for the possibility that the GPS receiver
fails or runs out of power**



But also ...





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Each Tool Has Advantages



Compass

fast to access if worn around the neck
works under dense trees that can block

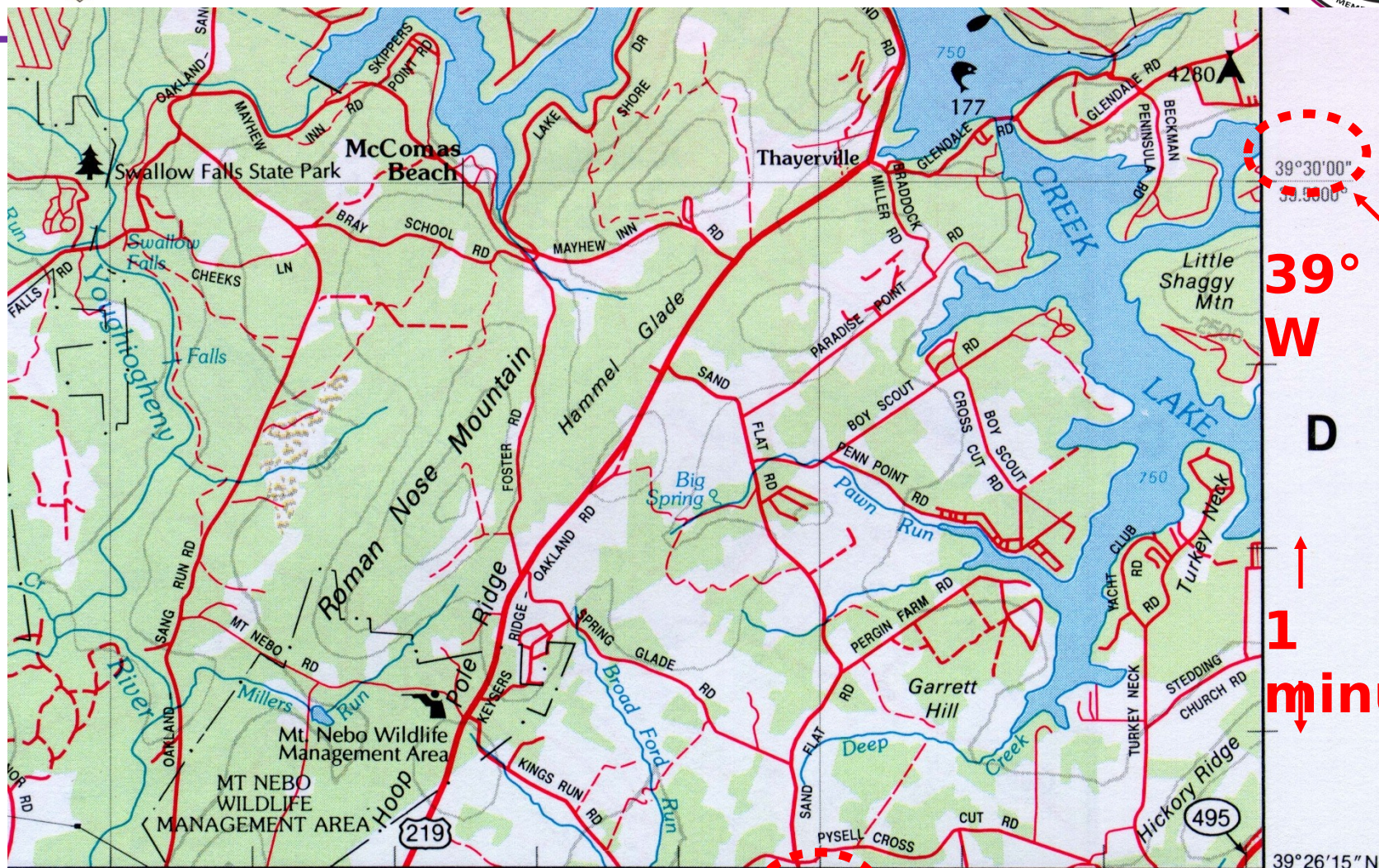
GPS

Printed Map

Can give you the “big picture”
May show features not on digital maps
May be more up-to-date



Example Map



39°30'00"
39.5000°

39° 30' N
W

D

1
minute

39°26'15"N
79°16'53"W

79°25'00"
79.4167°

Continue on inset left

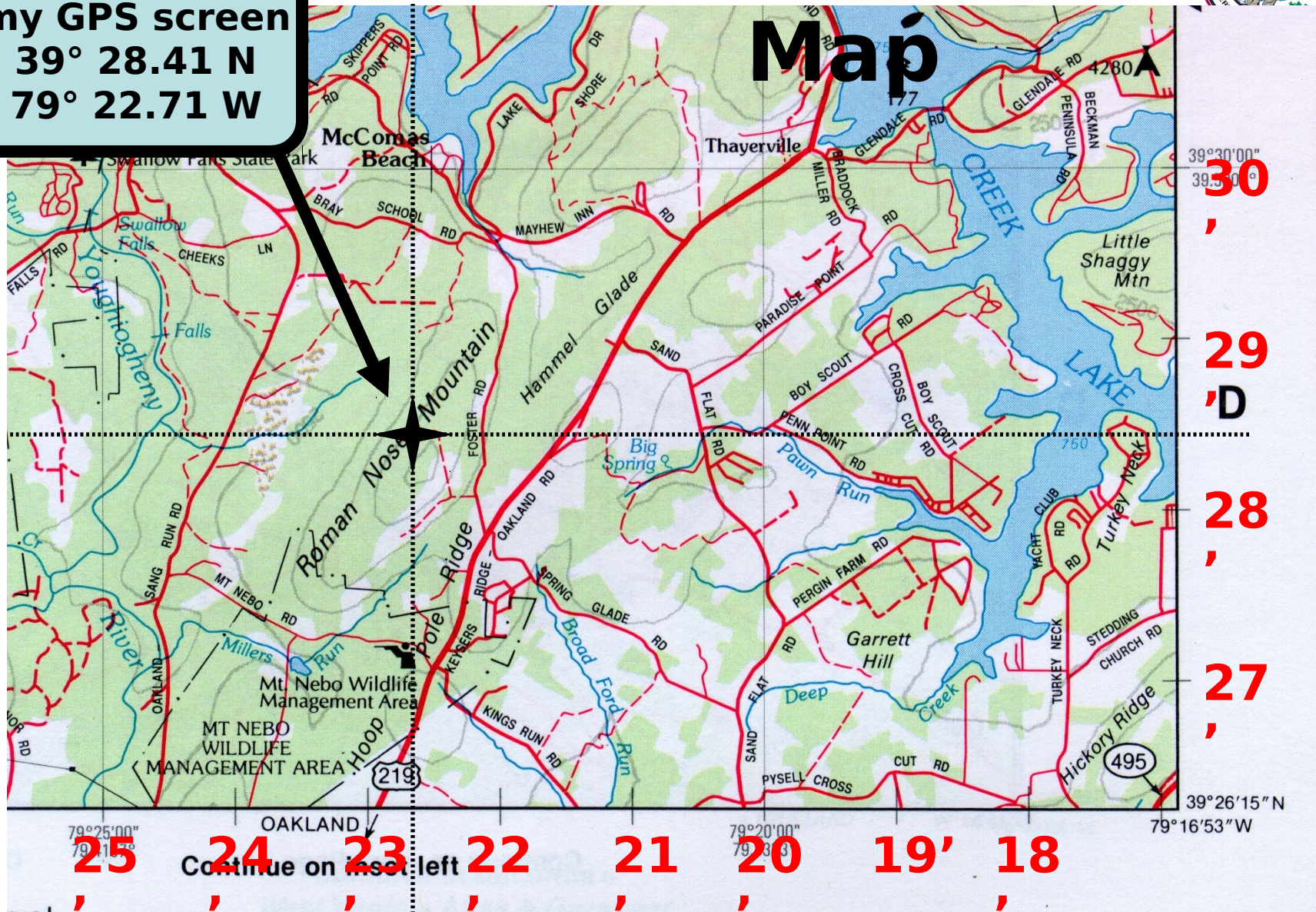
79°20'00"
79.3333°

79° 20'
W

Plotting GPS on Map



my GPS screen
39° 28.41 N
79° 22.71 W



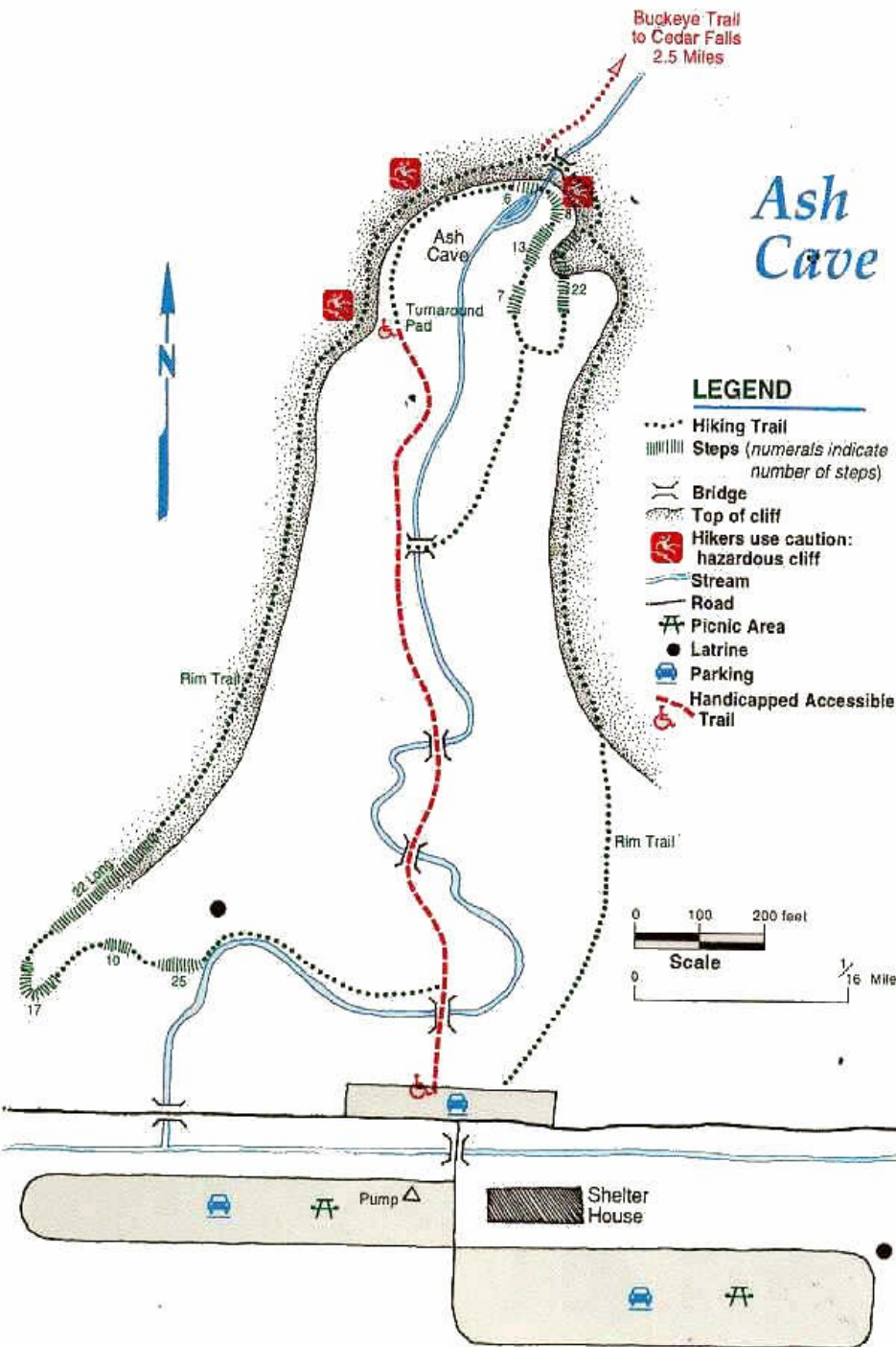
I've just "eyeballed" the distance between the minute marks



**But my
map has
no lat/lon**

No problem!

Navigate by waypoint

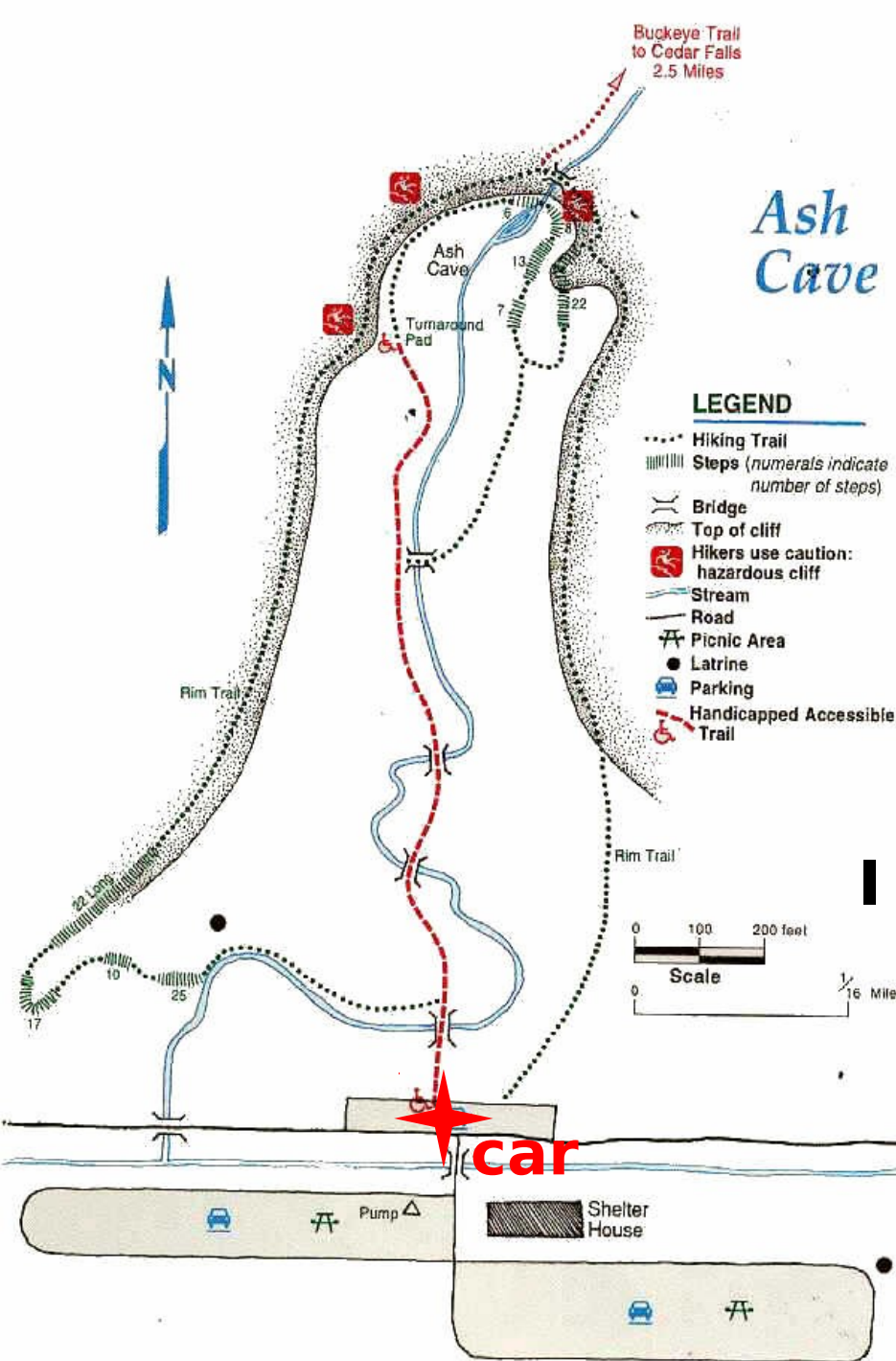




Waypoint method, Step 1

**Record a waypoint
Where you park your car**

**I always name this waypoint
“car”
For easy reference**

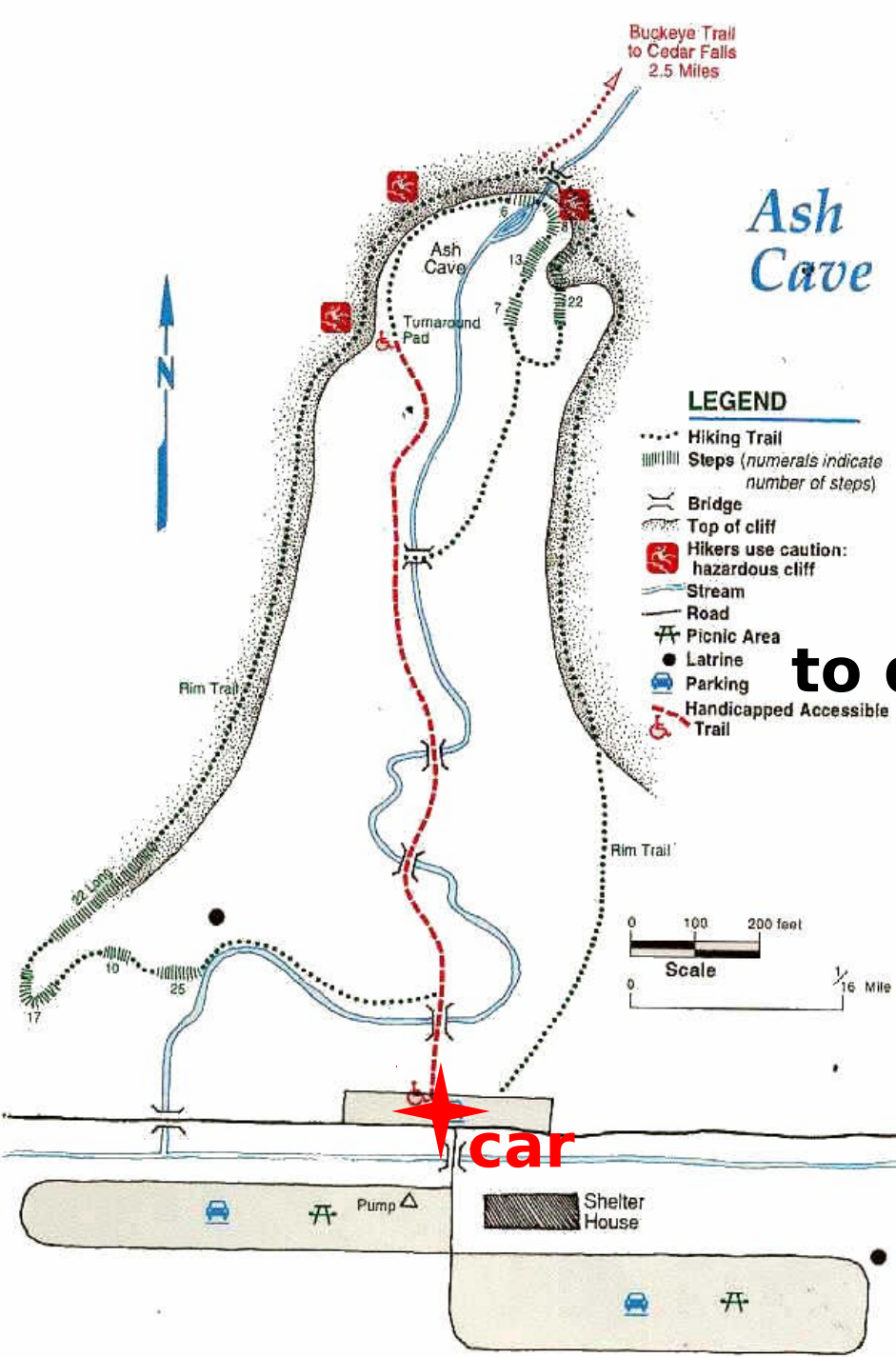




Waypoint method, Step 2

**Set your GPS receiver
to display distance and heading
to this waypoint**

**Set the distance units to
whatever is used on the
map (feet in this case)**





Waypoint method, Step 3

As you walk, use the heading

“I’m walking north”

I’ve come 300 feet
North, so I must be
here

“I’ve come 300 feet from the ca

To navigate





Waypoint method, Step

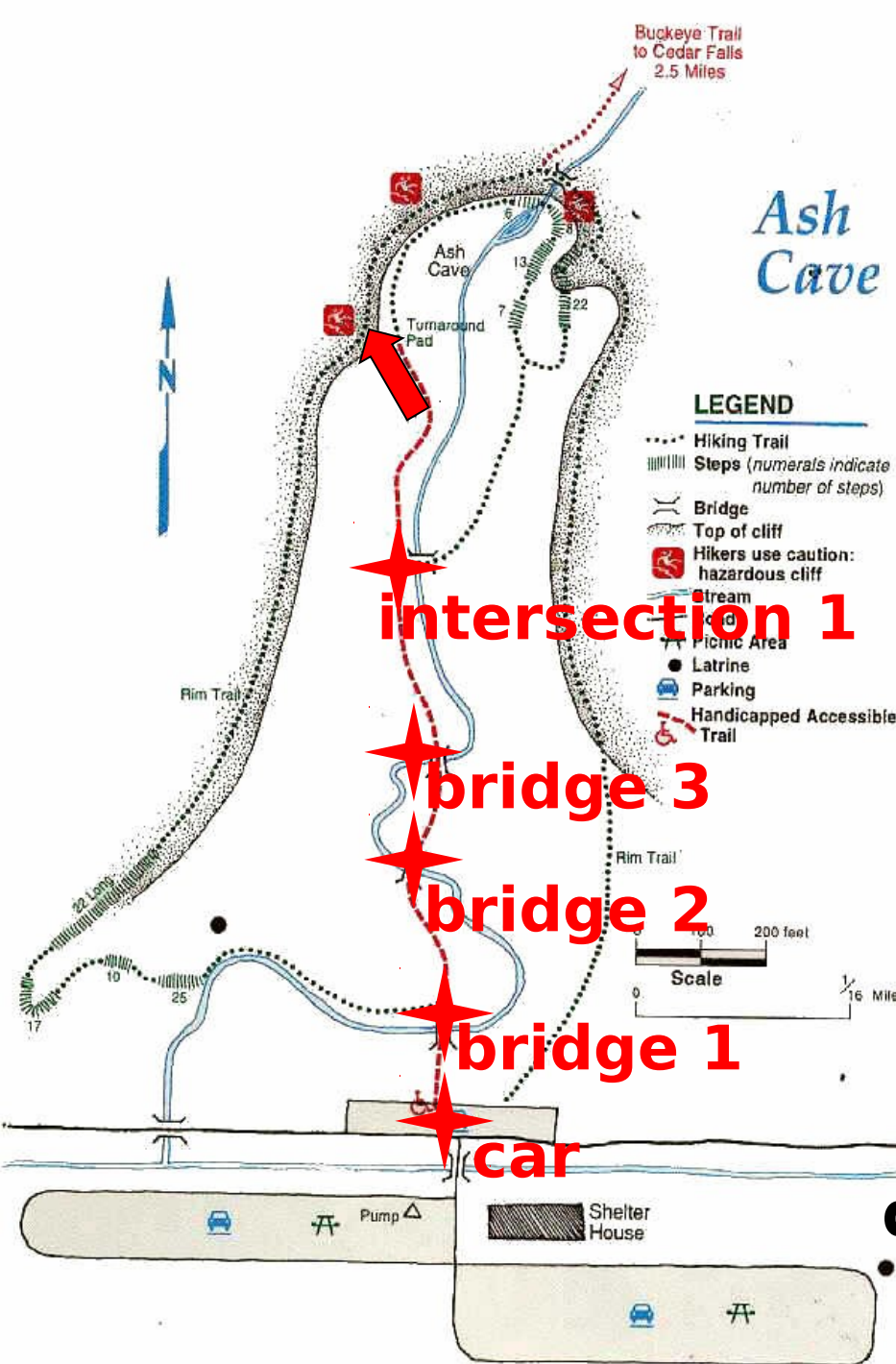
4

As you continue walking
add more waypoints
when you arrive at
easily identifiable places

bridges, streams
Train intersections
summits, lakes, etc.

mark them on your map

display distance & heading
to them





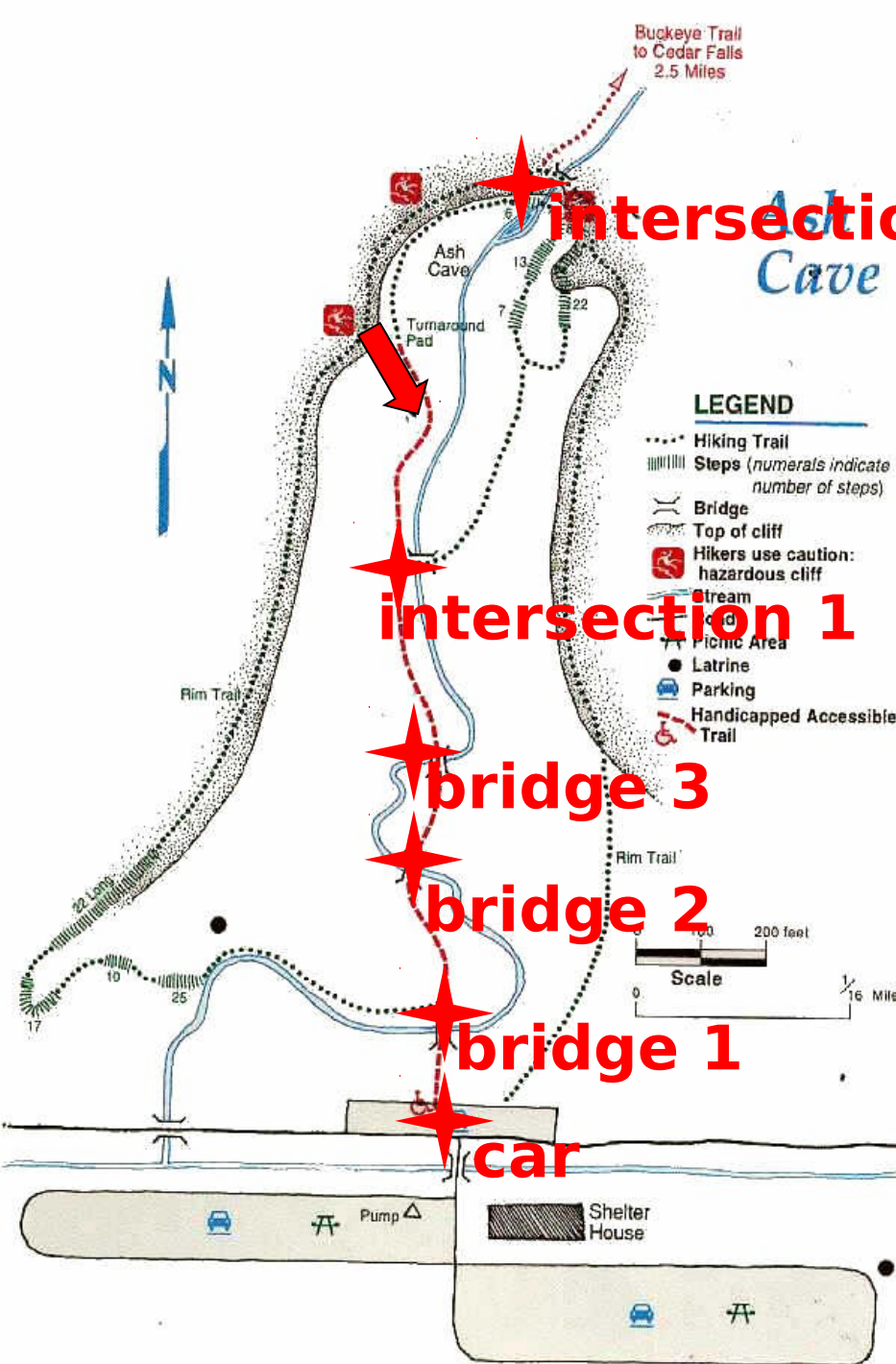
Waypoint method, Step

5

On the way back

use each waypoint in
succession

Switching to the
Next when the distance
To the current one gets
close to zero





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Avoiding the Hazard



You must know its coordinates
or at least the coordinates of a safe route

You must have adequate time to avoid it
and not be distracted doing other things

You must allow leeway for errors
including both GPS errors and human errors



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Hazard Avoidance

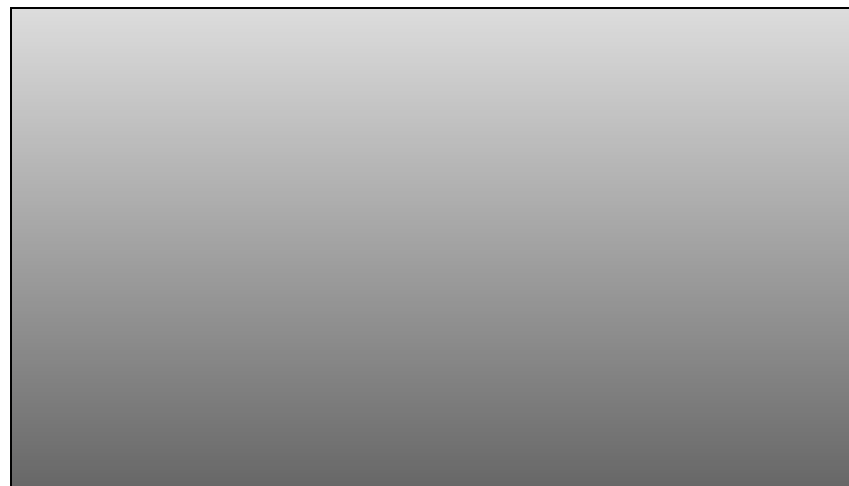


Why can't I see the hazard?

its night*

the weather is horrible*

the hazard is invisible
underwater obstacle
a political boundary



View from cliff edge in dense fog

*Sure, GPS can help.
But maybe you should
wait until you can see
that hazard?

E **on!**





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Following the Channel



GPS

works well to help guide small craft
through navigation channels and
past

hazards such as shallow water,
submerged obstacles, surf, rocks,
etc.

but ...



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Following the Channel, continued



It needs to be used in conjunction with
an accurate navigation chart –

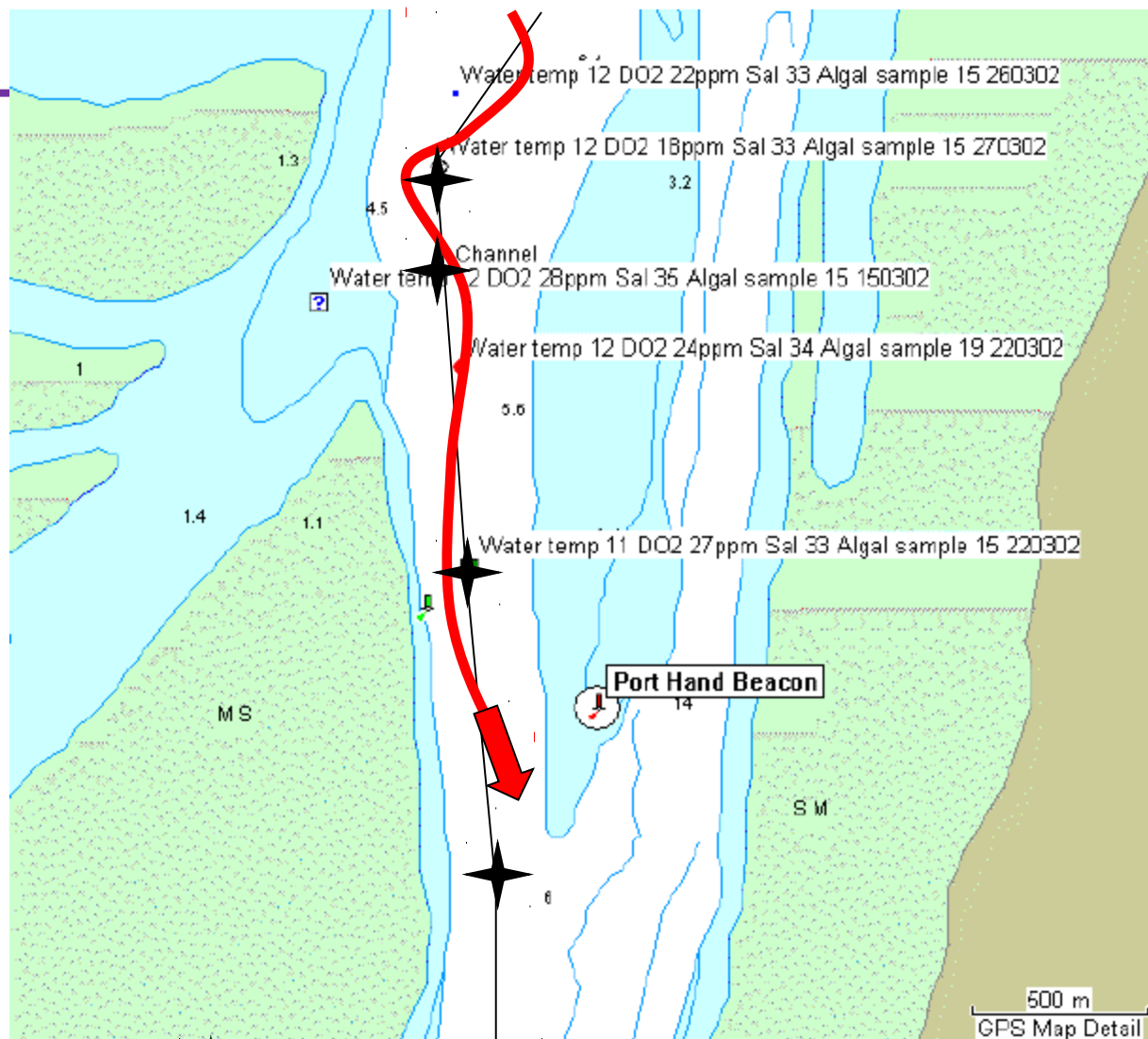
preferably with a route set in the
receiver

and with the receiver displaying both
the

desired route and your actual track
on

a map

Map showing route



desired route with waypoint

actual route



**But
beware**

strong currents and winds can force you
near a hazard you're doing your best to avoid



I was trying ...
to head to shore !

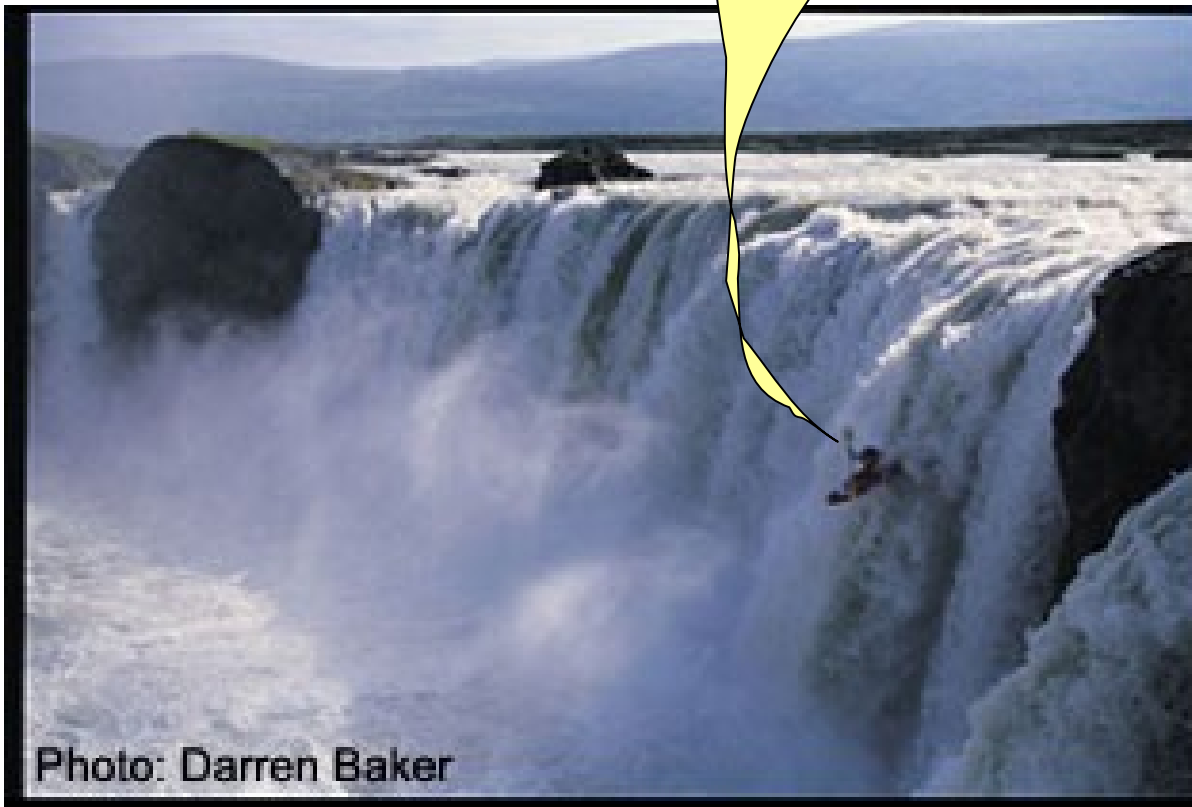


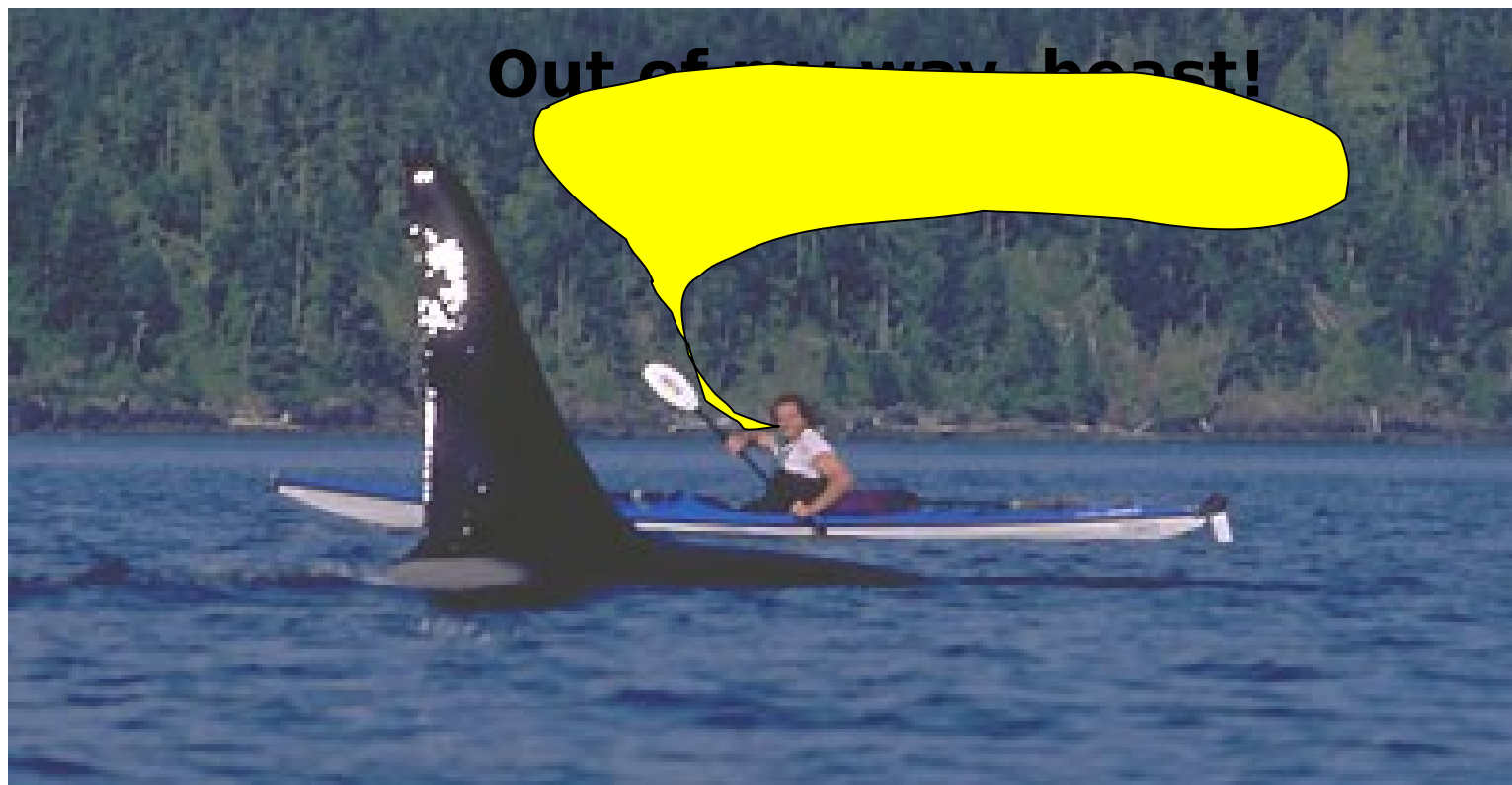
Photo: Darren Baker



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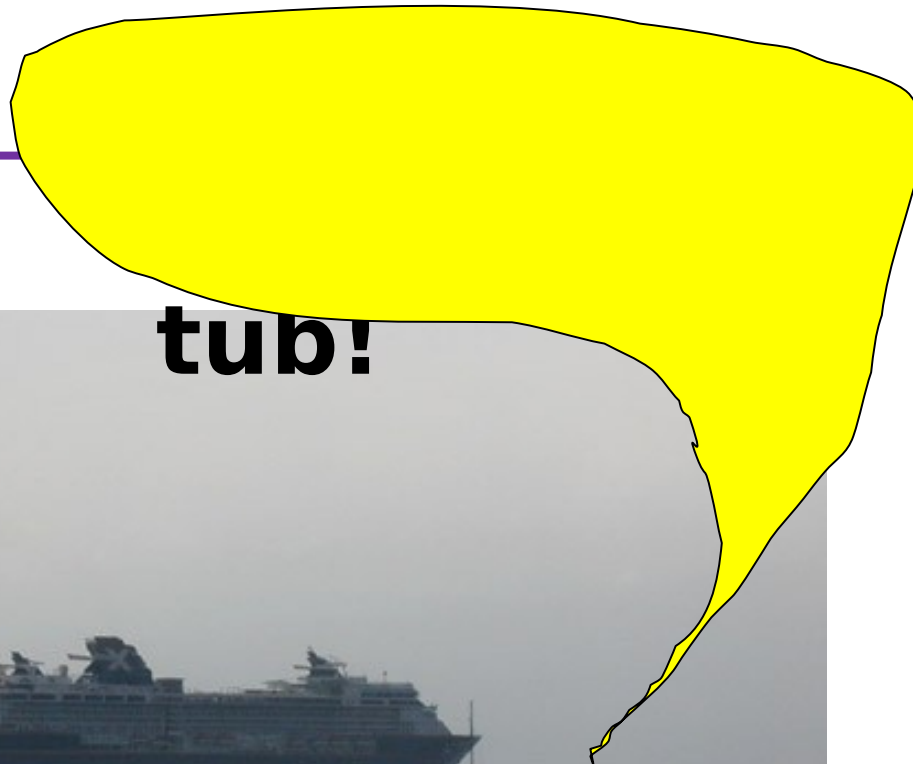


But remember, not all hazards are stationary ...





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tub!





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Emergency Situations



Knowing where you are is only one small element of dealing with an emergency situation ...

... but it can help ...

... rescuers find you ...

... if you can communicate with them

... you plan for a “hike out” ...

... though that is not always the wisest course of action

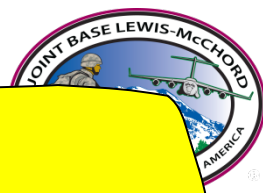


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Communicating your location



How much confidence do you have that a 911-operator can properly route an emergency call if all you give for your location is a latitude and longitude ?



I'm at latitude $48^{\circ} 51.72' \text{ N}$,
longitude $120^{\circ} 31.92' \text{ W}$





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Maybe this would have been better ...

Hello 911, I'm in Calpanga National Park, on the west side of Smerton's Peak, bivouacked on a ledge approximately 900 feet below the summit, and about a quarter mile south of Horse Rock, and my GPS coordinates are latitude $48^{\circ}51.72'N$, longitude $120^{\circ}31.92'W$ in the WGS-84 datum



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Rescue Beacons



e.g. GPS-enabled PLB's and EPIRB's



advantages

More reliable and better coverage than cell phone or VHS radio.

Completely automatic once activated, which counts if your injured.

disadvantages

sends only rescue request and GPS location

rescue response system proven at sea, but not on land

no way to confirm that help is on the way



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GPS Tip 1



**Enter 2 to 3 waypoints
before your trip**

***even if you have to key them in by
hand***

**shelters or campgrounds
lakes**

Mountain peaks

**Both for safety sake and
to facilitate navigation**



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GPS Tip 2



**Record a waypoint where
you parked your car!**

***It makes it easier to find
if you should return by a different
route than by which you set out!***



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GPS Tip 3



**Record waypoints at
major trail intersections
And especially confusing
ones**

***plot them on a printed map
along with arrows showing
which way you went***



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GPS Tip 4



**Record a waypoint
whenever
you stop for a break**

***In case you have to go back to
get something you accidentally left !***



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GPS Tip 5



**Draw minute grid on
printed
maps before trip**
and before map-sealing paper maps

And

**Write minutes on map
so they show when map
is folded to pocket size**

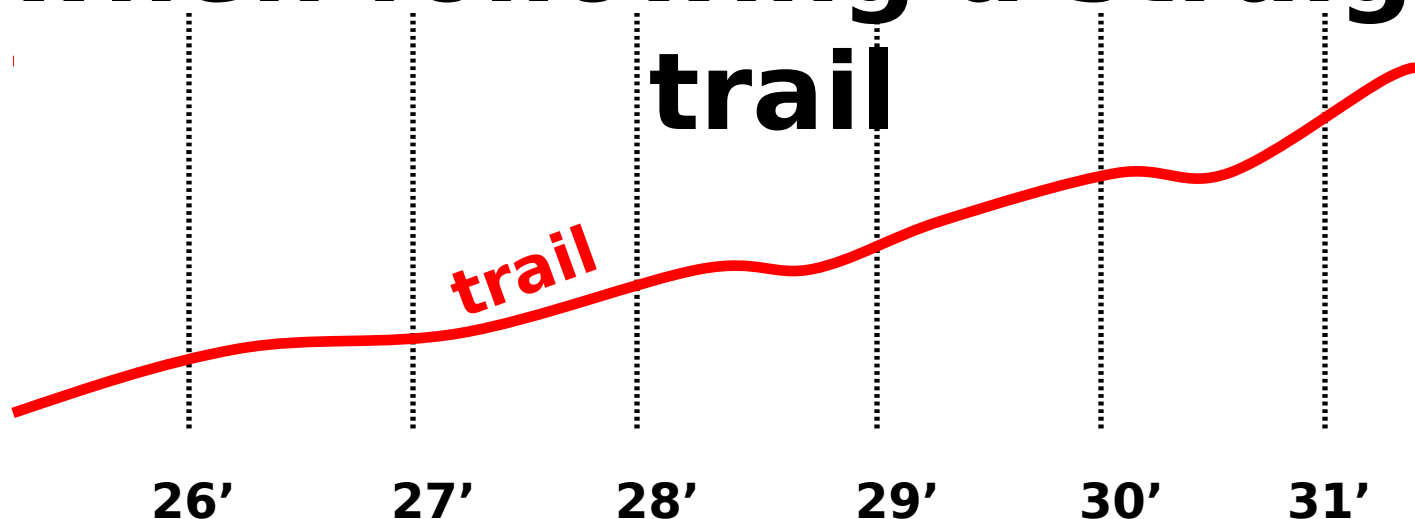


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GPS Tip 6



**Navigate using just
longitude
(or just latitude)
when following a straight
trail**





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GPS Tip 7



Display Speed When kayaking through strong currents

**You can monitor whether
your making progress
and
*spot when you're in a favorable
eddy***



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GPS Tip 8



**You may
know where you are**

and

know where you're going

***But GPS does not tell you how
to get there***



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Oops !

It didn't look
so steep
on the map !





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Plan your Route !



Look carefully at maps

**Refer to guidebooks
and hiking club web sites**

Don't be afraid to ask for advice



blaming!